SARS and Health Worker Safety: Lessons for Influenza Pandemic Planning and Response

COMMENTARY

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To the memory of Mr. Justice Archie Campbell

ABSTRACT

The outbreak of severe acute respiratory syndrome (SARS) in 2003 provided valuable lessons for protecting health workers during an influenza pandemic or other public health crisis. In its final report, the SARS Commission concluded that a key lesson in worker safety was the precautionary principle. It stated that reasonable actions to reduce risk should not await scientific certainty. As recommended by the SARS Commission, this principle has now been enshrined in the Health Protection and Promotion Act (2007), Ontario's public health legislation and in Ontario's influenza pandemic plan. Another vital lesson for worker safety involves the occupational hygiene concept of a hierarchy of controls. It takes a holistic approach to worker safety, addressing each hazard through control at the source of the hazard, along the path between the worker and the hazard and, lastly, at the worker. Absent such an approach, the SARS Commission said worker safety may focus solely on a particular piece of personal protective equipment, such as an N95 respirator (important as it may be), or on specific policies and procedures, such as fit testing the N95 respirator to the wearer (significant as it may be). In worker safety, said the commission, the integrated whole is greater than the uncoordinated parts. The third and final worker safety lesson of SARS is the importance of having a robust safety culture in the workplace in which workers play an integral role in promoting a safe workplace.

Regarded as the "first severe and readily transmissible new disease to emerge in the 21st century" (World Health Organization [WHO] 2003), many have called the 2003 outbreak of severe acute respiratory syndrome, or SARS, "a dress rehearsal" for an influenza pandemic (Andresen 2004; CBC Radio 2003 April 5; Clancy 2004; Public Health Agency of Canada 2006: 78).[2] Trying to contain a SARS outbreak or an influenza ("flu") pandemic – since both are caused by novel viruses – presents similar challenges.[3] Just as in the early phases of the SARS outbreak, when little was known about its causative agent, "during the initial stages of a pandemic … viral transmission and virulence characteristics are uncertain" (US Centers for Disease Control and Prevention 2006: 2). In the event of a pandemic, "no one knows how the [new influenza] virus would behave" (Health Canada and Public Health Agency of Canada 2006). It must be noted, however, that the challenge faced by the flu pandemic response will be somewhat easier. An existing wealth of knowledge about influenza viruses permits some perspectives even when a new influenza type A virus emerges. Indeed, we have had more than a decade to become familiar with the H5N1 avian flu virus now circulating in Asia, Africa and Europe, which some believe could give rise to a pandemic strain (World Health Organization 2004a):

> The first documented infection of humans with an avian influenza virus occurred in Hong Kong in 1997, when the H5N1 strain caused severe respiratory disease in 18 humans, of whom 6 died. The infection of humans coincided with an epidemic of highly pathogenic avian influenza, caused by the same strain, in Hong Kong's poultry population.
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> Extensive investigation of that outbreak determined that close contact with live infected poultry was the source of human infection. Studies at the genetic level further determined that the virus had jumped directly from birds to humans. Limited transmission to health care workers occurred, but did not cause severe disease.
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> Rapid destruction – within three days – of Hong Kong's entire poultry population, estimated at around 1.5 million birds, reduced opportunities for further direct transmission to humans, and may have averted a pandemic.
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> That event alarmed public health authorities, as it marked the first time that an avian influenza virus was transmitted directly to humans and caused severe illness with high mortality.

"Concerns about the likely occurrence of an influenza pandemic in the near future are increasing. The highly pathogenic strains of influenza A (H5N1) virus circulating in Asia, Europe, and Africa have become the most feared candidates for giving rise to a pandemic strain" (Tellier 2006 p. 1657).

There are also major differences between SARS and a flu pandemic that appear, at first glance, to reduce the relevance of SARS in flu pandemic preparedness. (Unlike influenza, which is caused by a member of the Orthomyxoviridae family of ribonucleic acid viruses, SARS was caused by a novel variety of a coronavirus. Before SARS, "coronaviruses in humans [were] usually considered to be the cause of nothing more serious than the common cold" (Cavanagh 2005: 4.) The most notable difference is that SARS in Toronto spread primarily in healthcare settings,[4] whereas a flu pandemic would affect the wider community. Paradoxically, it is precisely the

fact that SARS was a nosocomial disease whose greatest burden fell on health workers that makes the lessons from SARS valuable to those planning for, and responding to, a (quite dissimilar) community-centred public health emergency such as a flu pandemic. Indeed, as noted below, some of the SARS Commission's key worker safety findings and recommendations have become guiding principles in Ontario's flu pandemic planning and in legislation for managing public health emergencies.

There are two primary reasons why lessons regarding worker safety learned from the SARS outbreak are useful. First, worker safety is vital in the initial phases of a flu pandemic. As the *Ontario Health Plan for an Influenza Pandemic* states, "Workplace health and safety measures will be particularly important in the early phase of a pandemic, when there are only a small number of cases and there may be an opportunity to contain the virus and slow community spread" (Ontario Ministry of Health and Long-Term Care 2007: 7-4). Slowing community spread may buy some time while an effective vaccine is developed and produced.

> "… trying to coerce health workers to work in an unsafe environment they believe will harm themselves and their families is neither ethical nor enforceable.

Second, the importance of worker safety will continue even if the pandemic strain becomes widespread in the community. This is because a flu pandemic – whether as devastating as the one in 1918–1919 or less severe as the 1957 and 1968 events – would place unprecedented demands on health resources. "Health care systems in the developed world have rarely encountered the type of resource scarcities envisaged during an influenza pandemic" (Christian 2006). If there is any hope of meeting those demands, physicians, nurses and other health workers must be kept safe. The SARS Commission's second interim report stated, "The health and safety of emergency workers is a fundamental element of every emergency response. One of the strongest lessons from SARS is that the health and safety of health care workers and other first responders is paramount in a public health emergency. SARS demonstrated that an emergency response can be seriously hampered by high levels of illness or quarantine among health care workers" (Campbell 2005: 469).

It is not simply a matter of appropriately safeguarding health workers, however. They must also feel safe and trust the measures being taken to protect them. Otherwise, they may be less willing to take on the heightened risks inherent in a public health crisis, even if authorities attempt to legally coerce them do so. As the SARS Commission concluded, trying to coerce health workers to work in an unsafe environment they believe will harm themselves and their families is neither ethical nor enforceable. The commission's second interim report stated, "Health care workers and other front-line responders may decide in future emergencies, as so many did so heroically during SARS, to accept heightened levels of personal risk voluntarily. But no one, no matter how dedicated and conscientious, should or can be legally coerced to work in an unsafe work environment that they believe will harm themselves and their families. And as a practical matter such legal coercion would be impossible to enforce (Campbell 2005: 470).[5]

The Precautionary Principle

The SARS Commission's final report said

the foremost worker safety lesson of SARS is the precautionary principle. Justice Archie Campbell, the late SARS commissioner, found a large body of evidence supporting his finding that in a public health emergency, reasonable action to reduce risk should not await scientific certainty. The importance of the precautionary principle is a central theme of Mr. Justice Campbell's 2006 report, especially in the introduction (pp. 1–14).

Some of the strongest evidence came from the SARS experience in British Columbia. Its index patient presented to hospital on March 7, 2003, within a few hours of the index patient in Ontario entering hospital in Toronto. Yet, in Ontario, SARS killed 44 and struck down more than 330 others with serious lung disease, including 247 probable cases (Campbell 2006: 1). British Columbia had just four probable cases and only one case of local transmission, which involved a nurse. No other nurse, physician, respiratory therapist, cleaner or other BC health worker caught the disease (Campbell 2006: 245). While some have suggested that good fortune was the reason for British Columbia's better outcome, Mr. Justice Campbell found that the province had "made its own luck." In his view, a key reason why it was spared Ontario's devastation was the precautionary approach taken by institutions such as Vancouver General Hospital, which treated British Columbia's index patient (Campbell 2006: 296).

The SARS Commission's final report said the precautionary approach "was in use at Vancouver General Hospital when it received B.C.'s first SARS case on March 7, 2003, the same day Ontario's index case presented at the Scarborough Grace Hospital [in Toronto]. When dealing with an undiagnosed respiratory illness, health workers at Vancouver General automatically go to the highest level of precautions and then scale down as the situation is clarified. While the circumstances at Vancouver General and the Grace Hospital were different, it is not surprising that SARS was contained so effectively at an institution so steeped in the precautionary principle" (Campbell 2006: 27).

Since the SARS Commission's final report, the precautionary principle has become enshrined in the *Health Protection and Promotion Act* (2007), Ontario's public health legislation,[6] and it now provides fundamental guidance to Ontario's flu pandemic response. The section of the revised *Ontario Health Plan for an Influenza Pandemic* (2007) that sets out the "Ethical Framework for Decision Making" states, "As noted by Justice Campbell in the final report of the SARS Commission (*Spring of Fear*, December 2006) we cannot always wait for scientific certainty before we take reasonable steps to reduce risk. Once an influenza pandemic emerges, outbreaks will spread rapidly across the globe and scientific evidence on the characteristics and epidemiology of the novel virus will be limited in the early stages. As a result, decision-making processes will apply the precautionary principle when there is scientific uncertainty" (Ontario Ministry of Health and Long-Term Care 2007: 2-8).

The precautionary principle also guides the Ontario flu pandemic plan's approach to occupational health and safety. The plan's worker safety chapter states: "This chapter was developed in collaboration with the Ministry of Labour and describes: the regulatory framework and legislated requirements, roles and responsibilities for workplace health and safety; the risks of influenza transmission in the workplace; the importance of education; the hierarchy of control measures that can reduce the spread of influenza in health care settings; and recommended infection prevention and control measures. Recommendations are based on the precautionary principle as set out by Justice Campbell in the final report of the SARS Commission (*Spring of*

Fear, December 2006)" (Ontario Ministry of Health and Long-Term Care 2007: 7-1).

Another important worker safety lesson arose from the controversy over whether N95 respirators and fit testing were really necessary. Using highly efficient filtering materials, N95 respirators are one of the nine types of disposable particulate respirators that are independently tested and certified by the National Institute for Occupational Safety and Health in the United States, which is part of the Centers for Disease Control and Prevention. "The *N* indicates that the respirator provides no protection against oils and the *95* indicates that it removes at least 95% of airborne particles during 'worst case' testing using a 'most penetrating'-sized particle" (Yassi et al. 2005). Fit testing helps users select a respirator that best fits their face and teaches them how to get a proper seal each time they use a respirator, a procedure known as a *seal check*, and how to safely don and doff a respirator. A test verifies that the chosen respirator works properly. There are two types of tests. One is called a *qualitative fit test* and "relies on the user's subjective response to taste, odour or irritation." The other is a *quantitative fit test* and "relies on an instrument to quantify the fit of a respirator" (Healthcare Health and Safety Association of Ontario 2000).

> … it's not about the mask; and it's not about fit testing. It's about a whole system of safety controls …

> During SARS … two approaches to worker safety – one based on the precautionary principle, the other on scientific certainty – came to a head over the issue of the N95 (a respirator that protects much more than a surgical mask) and fit testing. Some experts believed that since SARS was spread mostly by large droplets, surgical masks were sufficient in most situations. Others argued that since not enough was known about how SARS was spread, and since the possibility of airborne transmission by much smaller particles could not be ruled out, it was better to be safe than sorry and to require health workers to wear fit-tested N95 respirators. Knowledge about how SARS is transmitted has evolved significantly since the outbreak. Some recent studies suggesting a spread by airborne transmission lend weight to a precautionary approach to protect health workers against a new disease that is not well understood. (Campbell 2006: 26)

Hierarchy of Controls in Occupational Hygiene

Justice Campbell concluded that worker safety is not just about a particular piece of personal protective equipment like an N95 respirator (important as it may be) or about specific policies and procedures like fit testing (significant as it may be). It is about taking a holistic approach to worker safety as embodied in the occupational hygiene concept of hierarchy of controls. Occupational hygiene, which is often called *industrial hygiene* in the United States, is defined as follows: "the science and art of anticipating, recognizing, evaluating, and controlling chemical, physical, biological, ergonomic hazards that are in or originate from the workplace" (DiNardi and Luttrell 2000: 106). In worker safety, said the SARS Commission, the integrated whole is greater than the uncoordinated parts.

In a chapter of the SARS Commission's

final report appropriately titled "It's Not about the Mask," Campbell wrote: "Perhaps the most important respiratory protective lesson from SARS is the importance of focusing not just on one protective component, whether it's the N95 respirator or fit testing. To return to the title of this chapter, it's not about the mask; and it's not about fit testing. It's about a whole system of safety controls in which the respirator and other personal protective equipment are simply the last component, the final line of defence. That bigger safety system, of which the respirator is just one small part, is known as the hierarchy of controls" (Campbell 2006: 1111).

The Healthcare Health and Safety Association of Ontario states that under the concept of hierarchy of controls,

> All available options for controlling the hazard should be put into place and that when these controls are not possible or not sufficient to control the risk, personal protective equipment such as respirators should be implemented. The hierarchy of controls is as follows:
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> 1. Engineering controls
> 2. Administrative controls
> 3. Work practices
> 4. Personal protective equipment.
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> These controls are meant to address hazards through control at the source of a hazard, along the path between the worker and the hazard and lastly, at the worker. Controls that are implemented at the source should be put into place first. These include using engineering controls such as enclosing the hazard or using local exhaust ventilation. An isolation room with negative pressure ventilation is an example of an engineering control aimed at the source of the hazard.
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> Controls that are implemented along the path should be put in place next. These include general exhaust ventilation or the use of shielding or barriers. Administrative control and workplace practice controls are also critical. These controls include such program components as processes to ensure early recognition and appropriate placement of patients who are infectious, surveillance for detection of outbreaks, adequate cleaning and disinfection of patient care equipment and the environment and education programs for health care workers about identifying and managing risk.
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> If, after implementing controls at the source and along the path does not eliminate the worker's risk of exposure, then controls at the worker can be put in place. These include the use of personal protective equipment such as respirators and eye protection.
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> The essential point from the hierarchy of controls is that employers should not rely exclusively on personal protective equipment (PPE) to protect workers. All other means of control should be used to protect workers and PPE used only when other controls have not eliminated or reduced the hazard significantly. (Healthcare Health and Safety Association of Ontario 2003: 11)

Significantly, since the final SARS Commission report was issued, the concept of hierarchy of controls has been enshrined in the Ontario flu pandemic plan: "Protection of workers from infectious diseases may be best achieved using a hierarchy of controls (i.e., at the source, along the path and with the worker). Reducing the risk of influenza transmission in the workplace requires a

comprehensive strategy that includes: engineering controls that make the work environment or setting safer; administrative and work practices that reduce the risk of infection; and personal protective equipment used by health care workers" (Ontario Ministry of Health and Long-Term Care 2007: 7-7).

"The SARS Commission also pointed to the importance of having sufficient numbers of qualified and trained occupational hygienists during a public health crisis.

The SARS Commission also pointed to the importance of having sufficient numbers of qualified and trained occupational hygienists during a public health crisis. Their value was demonstrated when the commission compared the way in which N95 respirators were introduced to health workers in Toronto and at British Columbia's Fraser Health authority. In Toronto, many health workers told the commission they were given no instruction on how to use an N95 respirator, or on its limitations, and were not fit tested until after the end of the outbreak. They often were forced to rely on the instructions printed on the respirator box or on second-hand information from colleagues during shift changes. The commission documented instances where health workers who contracted SARS had thought it was all right to wear a surgical mask under an N95 respirator, to stuff tissues between the mask and their face or to wear a respirator over a beard. These practices tend to prevent the direct skin-to-respirator contact needed to create a proper seal (Campbell 2006: 1074–82).

Contrast this with the actions at the Fraser Health authority. (Fraser Health is one of British Columbia's five health authorities. Headquartered in Surrey, British Columbia, Fraser Health oversees the health region east of Vancouver, supervises 12 acute care hospitals with about 2,000 acute care beds, employs about 21,000 people and has a budget of $1.8 billion. It serves about 1.5 million people.) Amid the chaos of trying to contain SARS, Fraser Health did not leave health workers to fend for themselves. It quickly recognized the need to properly train and fit test them. When supply shortages made fit testing impossible, it had the occupational hygiene resources to make the best of a difficult situation. A Fraser Health occupational hygienist told the commission:

> We had enough N95s just to cover the staff that were going into the patients' isolation room, within our emergency departments we did not have enough to provide for all the staff for fit testing and everything, so at that point in time what we did is we provided them with education on how to put it on and how to take it off properly, we went through the fit check, we went through all that information, we visually inspected as best we could whether they were getting a good seal but because we did not have enough N95s we could not fit test everybody at that point. So we were in communications with our purchasing department and trying to get any N95s that were available so that we could obviously proceed to a higher level. (Campbell 2006: 281)

Fraser Health demonstrated the type of innovative thinking that may be vital during a flu pandemic. A flu pandemic would likely create similar shortages of personal protective equipment and other medical equipment

and supplies, underlining the importance of having sufficient occupational hygiene resources to help mitigate the worker safety consequences of such shortages. The possibility of these shortages is reinforced by Gensheimer et al. (2003), who stated, "In the initial stages of, and potentially throughout, an influenza pandemic or a bioterrorist attack, there will be a shortage of many essential resources, including medical equipment and supplies, personnel, vaccines, and drugs."

"SARS also demonstrated the importance of a strong safety culture.

A Robust Safety Culture

SARS also demonstrated the importance of a strong safety culture.[7] Its key elements include close co-operation between infection control and occupational hygienists, listening to workers' concerns and ensuring workers have a dynamic role to play in their workplaces through effective internal responsibility systems. Regarding close co-operation between infection control and occupational hygienists, Justice Campbell stated:

> As Health Canada noted in a worker safety manual issued in 2002, close cooperation between worker safety and infection control is essential for the safe operation of a health care facility. Health Canada's *Prevention and Control of Occupational Infections in Health Care* says: "A component of the [worker safety] program relates specifically to infection control and must be planned and delivered in collaboration with the Infection Control (IC) program of the workplace ... This document supports the close collaboration of OH personnel with those responsible for the IC program … It notes the essential collaboration of both groups working together where responsibilities overlap, especially in the management of outbreaks." Tragically, this knowledge was not used during SARS. This expertise was ignored. (Campbell 2006: 1113)

Regarding the element of listening to workers' concerns, the commission noted that this was an integral component of Vancouver General's robust safety culture. Dr. Elizabeth Bryce, an infection control expert at Vancouver General, said: "And we get the feedback from the workers … I mean you know we are not working in isolation here. You have to respect the opinions of the health care workers. And they have to have confidence in the system and in what you are doing for them. If they don't have confidence, then you won't have people coming to work … " (Campbell 2006: 262).

Finally, pertaining to the dynamic role that workers play in their workplaces, the Ministry of Labour described the Internal Responsibility System as follows: "Employers, workers and others in the workplace share the responsibility for occupational health and safety. Each party is responsible to act to the extent of the authority that they have in the workplace. This concept of the internal responsibility system is based on the principle that the workplace parties themselves are in the best position to identify health and safety problems and to develop solutions. This concept emerged from the Royal Commission into health and safety in mines in Ontario in 1976 and was soon adopted as the basis of the new *Occupational Health and Safety Act* in 1978" (Ministry of Labour 2003, November: 6).

Justice Campbell found evidence of a

strong safety culture in British Columbia and its absence in Ontario:

> The Vancouver experience demonstrated the value of a safety culture in health workplaces. Expressions of this safety culture included the close cooperation and mutual respect between infection control and worker safety, the emphasis on listening to health workers, and the deployment of joint teams of infection control and worker safety experts …
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> In Ontario, infection control and worker safety disciplines generally operated as separate silos during SARS. Until this divide is bridged and infection control and worker safety disciplines begin to actively and effectively cooperate, it will be difficult to establish a strong safety culture in Ontario. (Campbell 2006: 44)

In addition, the outbreak of SARS demonstrated that in an emergency like SARS or a flu pandemic, it is vital to compensate those who suffer an unfair burden of personal cost for co-operating in public health measures like quarantine (Campbell 2006: 35). Thus, in the event of a flu pandemic, it would be important for healthcare employers to encourage, and provide sufficient financial support, for staff who were household contacts of persons with influenza, or who had influenza, so they could quarantine themselves without fear of negative financial or employment-related consequences. At the same time, healthcare employers should also actively discourage those staff members who should stay at home from coming to work.

Conclusion

Despite the many differences between the SARS outbreak in 2003 and an influenza pandemic, the experience with SARS nevertheless provides valuable lessons for protecting health workers during an influenza pandemic or other public health crisis. These include the importance of the precautionary principle, the occupational hygiene concept of hierarchy of controls and a robust safety culture.

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Notes

1 The SARS Commission was established in June 2003 to investigate the SARS outbreak in Ontario. The Commissioner was one of Canada's most respected jurists, Justice Archie Campbell of the Ontario Superior Court of Justice. He died in April 2007 after a lengthy battle with a degenerative lung disease. He was 65. The commission completed its work in January 2007 with the release of its third and final report. All three reports are available at www.sarscommission.com.

2 First appearing in or about November 2002 in Guandong, China, SARS would go on to infect 8,096 people around the world and kill 774 before ebbing in the summer of 2003 (Campbell 2006: 39–40). The following six jurisdictions had the majority of probable cases and fatalities: China (5,327 probable cases and 349 deaths), Hong Kong (1,755 probable cases and 37 deaths), Taiwan (346 probable cases and 37 deaths), Singapore (238 probable cases and 33 deaths), Canada (251 probable cases and 44 deaths) and Vietnam (63 probable cases and five deaths) (World Health Organization 2004b).

3 WHO has identified three prerequisites for the start of a pandemic:

1. A novel virus subtype must emerge to which the general population will have no or little immunity.
2. The new virus must be able to replicate in humans and cause serious illness.
3. The new virus must be efficiently transmitted from one human to another; efficient human-to-human transmission is expressed as sustained chains of transmission causing community-wide outbreaks. (2005: 11)

4 Seventy percent of patients with probable and suspected cases in Ontario contracted the disease in healthcare settings (Campbell 2006: 22). Of the total number of probable and suspected SARS cases in Ontario, 169 (45%) involved health workers (Campbell 2006: 1046). There were some significant instances where SARS was spread in the community. The largest was in Hong Kong, where more than 300 people contracted SARS in four separate buildings at the Amoy Gardens high-rise complex (Yu et al. 2004).

5 Amendments to the Health Protection and Promotion Act (2007), Ontario's public health legislation, which received Royal Assent on June 4, 2007, appear to address this issue:

> Directives to health care provider
> 77.7 (1) Where the Chief Medical Officer of Health is of the opinion that there exists or there may exist an immediate risk to the health of persons anywhere in Ontario, he or she may issue a directive to any health care provider or health care entity respecting precautions and procedures to be followed to protect the health of persons anywhere in Ontario …
> (3) A health care provider or health care entity that is served with a directive under subsection (1) shall comply with it.
>
> No coercion of professionals
> (4) For greater certainty, a directive under subsection (1) may not be used to compel regulated health professionals to provide services without their consent. (c. 10, Sched. F, s. 15)

6 Amendments to the *Health Protection and Promotion Act* (2007), Ontario's public health legislation, which received Royal Assent on June 4, 2007, state the following:

Precautionary principle
(2) In issuing a directive under subsection (1), the Chief Medical Officer of Health shall consider the precautionary principle where,
(a) in the opinion of the Chief Medical Officer of Health there exists or may exist an outbreak of an infectious or communicable disease; and
(b) the proposed directive relates to worker health and safety in the use of any protective clothing, equipment or device. (c. 10, Sched. F, s. 15)

7 A definition of safety culture suggested by the Health and Safety Commission in the U.K. is as follows (Institution of Engineering and Technology 1993):

> The safety culture of an organisation is the product of the individual and group values, attitudes, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety programmes. Organisations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventative measures.
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> A positive safety culture implies that the whole is more than the sum of the parts. The different aspects interact together to give added effect in a collective commitment. In a negative safety culture the opposite is the case, with the commitment of some individuals strangled by the cynicism of others. From various studies it is clear that certain factors appear to characterise organisations with a positive safety culture.
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> These factors include:
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> - The importance of leadership and the commitment of the chief executive
> - The executive safety role of line management
> - The involvement of all employees
> - Effective communications and commonly understood and agreed goals
> - Good organisational learning and responsiveness to change
> - Manifest attention to workplace safety and health
> - A questioning attitude and a rigorous and prudent approach by all individuals
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> The Institution of Engineering and Technology, "Health and Safety Briefing," No. 07, December 2006, p.1.

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